to affect the upper currents of the atmosphere, but, if growing large, soon afterwards do so, in such a manner that the hypothetical isobars at the level of the cirrus appear to be bent into a V-shaped hollow from the great polar depression to a point nearly above the centre of the circular depression at the earth's surface.

Of the depressions lately developed near the British Isles and over the south-west of France, the greater number originated in "troughs" of relatively low pressure, such as have been above alluded to: and their movements may be said to have been unusually erratic. Yet they obeyed the ordinary rule of progression, in so travelling, as to have the highest general pressures on the right of their course. Thus, those depressions which originated near the east side of a "trough" lying north-north-west to south-south-east, tended to move to north-north-west, while those which originated on the other side of the "trough" travelled in the contrary direction. On the 10th inst., Great Britain lay between two depressions travelling in parallel but opposite directions, these directions being transverse to the mean direction of movement prevalent at this season of the year. The same phenomenon was repeated on the 12th inst. It is now more than twenty years since I began constructing daily charts of the directions taken by European depressions, and during the whole of that period there has been no instance entirely comparable with these.

We must wait for reports from a very extensive portion of the earth's surface before a comprehensive study of these phenomena can be undertaken. Two questions, so correlated that they may require but a single answer, are of prime importance:—What causes the abnormal, but temporarily persistent, determination of aqueous vapour to certain portions of the globe? What causes the abnormal, but temporarily persistent, occupation of certain portions of the globe by anticyclonic systems?

W. CLEMENT LEY

THE WORK OF THE UNITED STATES FISH COMMISSION

A BRIEF memorandum of what the U.S. Fish Commission hopes to accomplish in time, in connection with its mission, is as follows:—

(1) In the department of investigation and research there is yet to be carried out an exhaustive inquiry into the character, abundance, geographical distribution, and economical qualities of the inhabitants of the waters, both fresh and salt. The subject is practically unlimited in extent, and, so far as the ocean is concerned, has scarcely been touched. With the powerful apparatus, however, at the command of the Commission it is expected that much progress will be made year by year, and that the publication of the results and the distribution of duplicate specimens to colleges and academies in the United States will be carried out on a large scale, so as to meet a large and increasing demand from teachers and students.

(2) A second object, in connection with the sea fisheries, is the improvement of the old methods and apparatus of fishing and the introduction of new ones.

The work of the Commission in bringing to the notice of American fishermen the importance of gill-nets with glass-ball floats for the capture of codfish has already revolutionised the winter cod-fishery industry in New England. Looked upon almost with ridicule by the Gloucester fishermen, when first brought to their notice by the Commission, these nets have come rapidly into use, until at the present time they represent the most important element in the winter fisheries, the number of fish taken being not only much greater than heretofore but the fish themselves of finer quality.

The ability to maintain a successful fishery without the use of bait is of the utmost importance, in view of the fact that when the cod are most abundant bait is almost unprocurable. Other forms of apparatus of less importance have also been introduced, and a constant look-out is maintained, by correspondence and otherwise, in connection with the improvement of fishing machinery.

(3) Another important point for consideration is that of improvement in the pattern of fishing vessels. There is annually a terrible mortality in the fishing crews of New England, especially those belonging to the port of Gloucester, to say nothing of the total loss and wreck of the fishing vessels and their contents. There has gradually developed in connection with the mackerel and cod fisheries of New England a pattern of vessel which, while admirable for speed and beauty of lines and of rig, is less safe under certain emergencies than the more substantial and deeper vessel used abroad, especially in England and Scotland.

The subject of the best form of fishing vessel has been intrusted to Captain Collins, of the Commission, himself a most experienced fisherman, and, after a careful study of the boats of all nations, he has prepared a model which is believed to combine the excellences of both English and American vessels.

An appropriation will be asked from Congress for means to construct an experimental vessel and test its qualities; but until a successful experiment has been made it will be difficult to induce the fishermen to change their present form of construction.

(4) The fourth object of the Commission is to determine the extent and general character of the old fishing localities and to discover new ones. There is no doubt whatever that there still remain many important areas, even in the best-known seas, where the codfish and the halibut will be found in their former abundance. There has never been any formal investigation on this subject, and the banks that are known have been brought to light purely by accident. It is believed that by a systematic research and a careful survey the area of known grounds can be greatly extended.

There is very great reason to hope for successful results from this inquiry in the waters off the South Atlantic coast and in the Gulf of Mexico. These regions, the latter especially, may be considered as practically unknown, the few established localities for good fishing being in very small proportion to what must exist. It is here that the service of the fishing schooner referred to above, if means can be obtained to build it, will be brought into play, and it is not too much to hope that an industry will be developed that will represent to the Southern and South-Western States the same source of income and occupation that the mackerel, cod, and halibut furnish to the fishermen of New England.

(5) There is also much to be learned in the way of curing and packing fish for general and special markets. The American methods have grown up as a matter of routine, and are adapted to only one class of demand. There are, however, many modes of preparation which can be made use of to meet the wants of new markets; and thus we can enter more efficiently into competition with European nations for European trade, as well as for that of the West Indies and South America.

A great advance has already been made towards this desired improvement since the Centennial Exhibition of 1876, where many methods of curing and putting up fish were shown in the foreign sections that were almost entirely unknown in America. Notable among these were the preparations of sardines and other species of herring in oil, as well as in spiced juices. Quite recently this industry has been well established in Maine, amounting to a value of millions of dollars, and there are many other parts of the country where the same work can be done with other kinds of fish. The whole subject is receiving the careful consideration of the Commission, and numer-

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[1] From the "Report of the U.S. Commission of Fish and Fisheries" (Washington, 1885).

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ous facts bearing upon it have been announced in its reports and bulletins.

(6) The work of increasing the supply of valuable fishes and other aquatic forms in the waters of the United States, whether by artificial propagation or by transplantation, although very successful, may be considered as yet in its infancy.

It must be remembered that the agencies which have tended to diminish the abundance of the fish have been at work for many years and are increasing in an enormous ratio. This, taken in connection with the rapid multiplication of the population of the United States, makes the work an extremely difficult one. If the general conditions remained the same as they were fifty years ago, it would be a very simple thing to restore the former equilibrium.

At that time, it must be remembered, the methods of preservation and of wholesale transfer, by means of ice, were not known, while the means of quick transportation were very limited. Hence a small number of fish supplied fully the demand, with the exception, of course, of species that were salted down, like the cod, the mackerel, and the herring (including the shad). Now, however, the conditions are entirely changed. The whole country participates in the benefits of a large capture of fish, and there is no danger of glutting the market, since any surplus can be immediately frozen and shipped to a distance, or held until the occurrence of a renewed demand.

Another impediment to the rapid accomplishment of the desired result is the absence of concurrent protective legislation of a sufficiently stringent character to prevent unnecessary waste of the fish during the critical period of spawning, and the erection or maintenance of impediments to their movements in reaching the spawning-grounds. This is especially the case with the shad and the salmon, where the simple construction of an impassable dam, or the erection of a factory discharging its poisonous waste into the water, may in a few years entirely exterminate a successful and valuable fishery.

It is to be hoped that public opinion will be gradually led up to the necessity of action of the kind referred to, and that year by year a continued increase in the fisheries will be manifested. Even if this does not occur as rapidly as some may hope, the experiments so far furnish the strongest arguments in favour of continuing the work for a reasonable time. A diminution that has been going on for fifty or more years is not to be overcome in ten, in view of the increasing obstacles already referred to.

Among the species an increase of which in their appropriate places and seasons is to be hoped for, in addition to those now occupying the attention of fish-culturists, are the cod, the halibut, the common mackerel, the Spanish mackerel, the striped bass, or rockfish, &c.

One of the most important, and at the same time among the most promising, fish is the California trout, with which it is hoped to stock large areas of the country. Its special commendations are mentioned elsewhere in this Report.

Another fishery earnestly calling for assistance, and capable of receiving it, is that of the lobster, the decrease of which has been very marked. The experiments of the Fish Commission suggest methods by which the number can be greatly increased. Something, too, may be done with the common crab of the Atlantic coast and its transfer to the Pacific. Some kinds might also be advantageously brought to the eastern portion of the United States from the Pacific coast and from the European seas.

A subject of as much importance as any other that now occupies the attention of the Fish Commission is an increase in the supply of oysters. In no department of the American fisheries has there been so rapid and alarming a decrease, and the boasted abundance of this mollusk on the Atlantic coast, especially in Chesapeake Bay, is rapidly being changed to a condition of scarcity which threatens practical extermination, as is almost the case in England A fishing industry producing millions of dollars is menaced with extinction, and needs the most stringent measures for its protection.

The U.S. Fish Commission has been very fortunate, through its agents and assistants, in making important discoveries in connection with the propagation of the oyster, which are referred to hereafter in this Report; and it is proposed to establish several experimental stations for applying the discoveries thus made, so as to constitute a school of instruction and information to persons practically engaged in the business.

There are other shell-fish besides the oyster that will well repay the trouble of transplantation and multiplication. Among these are several species of clams belonging to the Pacific coast of the United States, which are much superior in size, in tenderness, and in excellence of flavour to those on the eastern coast. Most of these are natives of Puget Sound, and the completion of the Northern Pacific Railway is looked forward to as a convenient means of transferring them to Eastern waters. The common clams of the Atlantic coast are also fair subjects of experiment.

VOLCANIC DUST FROM NEW ZEALAND

A SHORT time since, Sir Julius von Haast sent me a small packet of volcanic dust from New Zealand, and requested me to examine it. The dust fell on June 10 of the present year (the day of the Tarawera eruption) at Matakava, Hicks Bay, 115 miles from the scene of the eruption. This dust is very fine, and, when regarded in the mass, is a dull, darkish gray colour. When examined under the microscope, it may be divided into—

(*a*) Bits of a more or less scoriaceous aspect—tiny lapilli, commonly almost opaque, being only translucent on thin edges—consisting of a somewhat brownish glass containing much disseminated ferrite. With reflected light they are a light to a darkish gray in colour, sometimes slightly reddish or brownish, with moderately rough surfaces. In size they usually vary from about ·005 to ·008 inch in the longest diameter; the former being the more common measurement; the latter is but rarely exceeded, the largest fragment in the portion which I have examined being ·012 inch in diameter; lapilli also occur of less than ·005 inch.

(*b*) Chips, more or less transparent, generally not exceeding ·005 inch in diameter, and of all dimensions downwards to the finest dust. The majority of these chips are glass, commonly quite colourless; some of them contain bubbles, spherical, spheroidal, or more or less cylindrical. Sometimes these are quite ·001 inch in longest diameter. Many chips show a ridgy surface, and are evidently formed by the destruction of a very frothy pumice like that of Krakatão. Some of the glass is of a light brown colour; occasionally it contains microliths of feldspar or trichites. The mineral chips are much less numerous than those of glass; the great majority of them are feldspar. Many of these are flat flakes apparently detached from a basal plane, but a few exhibit twinning. Some may be sanidine, but a plagioclastic feldspar is certainly present. The chips, however, are ill-suited for optical measurements, and the results which I have obtained are rather discordant. So far as I can come to a conclusion, I should say that the extinction-angles seem to indicate the not unfrequent presence of a feldspar which belongs rather to the oligoclase-albite group than to the labradorite-anorthite. I find very few indications of the presence of a pyroxenic constituent. One or two fragments are a greenish hornblende; three or four in general appearance resemble small flakes of magnesia-iron mica—lying on their basal faces, but some of these show dichroism, and only extinguish in certain positions between crossed Nicols, so that they cannot be this mineral. As to

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